Two-Dimensional Photoelectron Spectroscopy of Graphite Valence Band

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Abstract

As the direct probe for the valence electrons, angle-resolved photoelectron spectroscopy (ARPES) has been the indispensable tool for elucidating the electronic nature of various solids. ARPES gives the most detailed information about the band structure $E_B(\mathbf{k})$ resolved in binding energy (E_B) and wave vector **k**. However, investigations of ARPES so far have been concentrated in a certain two-dimensional cross-section of the valence band structure, i.e. two-dimensional band dispersion $E_B(k_x)$ or iso-energetic line shapes such as a cross-section of Fermi surface, $E_F(k_x,k_y)$. Here, we present the three-dimensional [E_B-k_x-k_y] dispersion surface of the π and σ bands of the single-crystalline graphite by using a two-dimensional display-type spherical mirror analyzer (DIANA). The π and σ band "surfaces" of graphite, measured and displayed three-dimensionally for the first time, contain fruitful information compared to the conventional band dispersion "curves" along a certain direction in **k** space. The slope and the curvature of local band structure correspond to the velocity and the mass of the valence electrons. By integrating band energy over entire Brillouin zone, the electronic part of the condensation energy is obtained. Furthermore, the atomic orbitals composing each band are determined from two-dimensional photoelectron intensity distribution by using linearly polarized synchrotron radiation.

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